

of solution, these complications are, to a large extent, avoided; and, as a matter of experiment, two fluid cells made up of metals immersed each in its own fused chloride, give results nearer the theoretical values than those obtained with aqueous solutions. This is specially noticeable in the case of metals with high heats of oxidation as in the case of magnesium and aluminium.

The electromotive forces of cells containing pairs of the metals, tin, lead, and zinc, come out nearest to the theoretical values. The other metals which were tried did not give so close an agreement, but can be brought into agreement by applying constant corrections, one for each metal; and reasons are given for attributing these corrections to the high temperatures of the cells as compared with the temperatures for which the recognised heats of combination are true.

Four of the cells were tested by passing currents through them in both directions alternately, and noting the electromotive force after the passage of each current. Polarisation was observed to a small extent in one case—zinc-silver; in the others it was practically absent.

- IV. "The Physiological Action of the Nitrites of the Paraffin Series considered in connexion with their Chemical Constitution. Part II. Action of the Nitrites on Muscular Tissue and Discussion of Results." By J. THEODORE CASH, M.D., F.R.S., Professor of Materia Medica in the University of Aberdeen, and WYNDHAM R. DUNSTAN, M.A., Professor of Chemistry to the Pharmaceutical Society of Great Britain. Received June 15, 1892.

(Abstract.)

Continuing the examination of the physiological action of various pure organic nitrites of the paraffin series (Part I; 'Roy. Soc. Proc.,' 1891), the authors have studied their effect on striated muscular tissue. When the vapours of these nitrites come into contact with the muscle a paralyssant effect is observed. All the experiments were made with the triceps and gastrocnemius of *Rana temporaria*. The muscle was contained in a specially constructed air-tight chamber, which, whilst it admitted of connexion being made between the muscle and the recording apparatus, rendered it possible to bring into contact with the muscle the vapour of a known quantity of the nitrite without any loss taking place. A very extensive series of experiments was necessary, as it is unsafe to contrast the gastrocnemius of one frog with that of another, so that the action of every

member of the series of nitrites had to be contrasted with each of the other members on the companion gastrocnemii of the same animal, and each experiment was repeated three times, and often five or six times. The amounts of the nitrites employed varied between  $\frac{1}{80}$  and  $\frac{1}{400}$  c.c.

Several series of concordant results have thus been obtained which lead to two different orders of activity, viz., (1) with reference to the extent to which equal quantities of nitrites shorten the resting muscle, and (2) with reference to the rapidity with which the shortening is produced. The order of activity of the nitrites as regards the extent of the shortening they induce is as follows:—(i) Iso-butyl, (ii) tertiary amyl, (iii) secondary butyl, (iv) secondary propyl, (v) propyl, (vi) tertiary butyl, (vii) butyl (viii)  $\alpha$ -amyl, (ix)  $\beta$ -amyl, (x) ethyl, (xi) methyl. The order representing the speed with which shortening occurs is (i) methyl, (ii) ethyl, (iii) secondary propyl, (iv) tertiary amyl, (v) primary propyl, (vi) tertiary butyl, (vii) secondary butyl, (viii)  $\alpha$ -amyl, (ix)  $\beta$ -amyl, (x) primary butyl, (xi) iso-butyl.

The effect of these nitrites in interfering with the active contraction of a stimulated muscle has also been studied, and it has been ascertained that very minute doses, insufficient to cause passive contraction, interfere in a marked degree with the active contraction and cause the muscle to fail in responding to stimulation, whilst the companion muscle, contained in a closed chamber free from nitrite vapour, still responded to stimulation.

The remainder of the paper is devoted to a discussion of the connexion between the various phases of physiological action and the chemical constitution of the nitrites which give rise to them. This discussion cannot be adequately abstracted. The principal conclusions which have been arrived at are briefly as follows:—The physiological action of these nitrites is not solely, and in some cases not even mainly, dependent on the amount of nitroxyl ( $\text{NO}_2$ ) they contain.

In respect of all phases of physiological activity, the secondary and tertiary nitrites are more powerful than the corresponding primary compounds. This is to be chiefly attributed not to the direct physiological action of the secondary and tertiary groups, but to the great facility with which these compounds suffer decomposition mainly into the alcohol and nitrous acid. In respect of the acceleration of the pulse, the power of the nitrites is directly as their molecular weight, and inversely as the quantity of nitroxyl they contain. They, therefore, fall into an order of physiological activity which is identical with that in which they stand in the homologous series. This same relationship, increase of physiological activity corresponding with rise in molecular weight, may also be traced, though less uniformly,

in their power of reducing blood-pressure, and of inducing muscular contraction.

This order appears to be the result not so much of the direct physiological influence of the substituted methyl groups as of the increased chemical instability which their presence confers on the higher members of the series. In respect of the duration of sub-normal pressure, as well as of the rapidity with which muscular contraction ensues, the activity of the nitrites is expressed by an order which is for the most part the reverse of that representing their power in accelerating the pulse, reducing blood-pressure, and contracting muscular fibre, this order being in general contrary to that of the homologous series. In these respects the more volatile nitrites of low molecular weight which contain relatively more nitroxyl are the most active. It appears probable that these simpler nitrites more readily attach themselves to certain constituents of blood and muscle, and thus act more quickly than the higher compounds, whilst their greater stability causes their effects, *i.e.*, reduction of blood-pressure, &c., to endure for a greater length of time than that of the higher and more easily decomposed bodies.

A large proportion of an organic nitrite is changed into nitrate in its passage through the organism, and is excreted as an alkali nitrate in the urine.

The results which have been gained by this research have an important bearing on the therapeutic employment of the nitrites. It is proposed elsewhere to consider what the outcome of this investigation is for practical medicine.

V. "On the Estimation of Uric Acid in Urine: a New Process by means of Saturation with Ammonium Chloride."  
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The process to be described depends upon the following facts:—

1. Ammonium urate is wholly insoluble in saturated solutions of ammonium chloride.

2. If solutions, such as urine, which contain the mixed urates of different bases be saturated with ammonium chloride, the large mass-influence of the latter ensures the rapid and complete conversion of all the uric acid into biurate of ammonium, which, in accordance with (1), is, *pari passu*, thrown out of solution. In the case of urine, saturation with ammonium chloride is followed by a complete precipitation of the uric acid present in the course of two hours at most.